

EIC Detector R&D update:

MCP-PMT at ANL

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Recent Progress

Detector optimization: Pixelated readout design

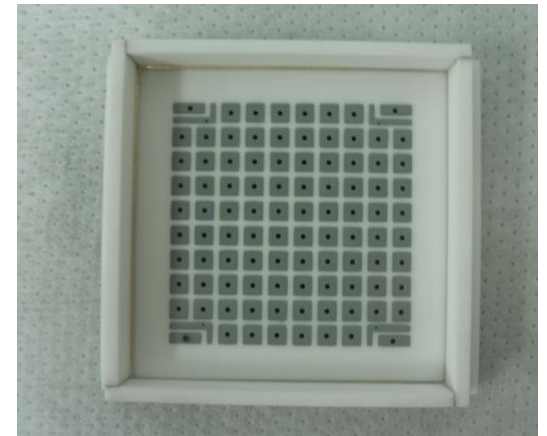
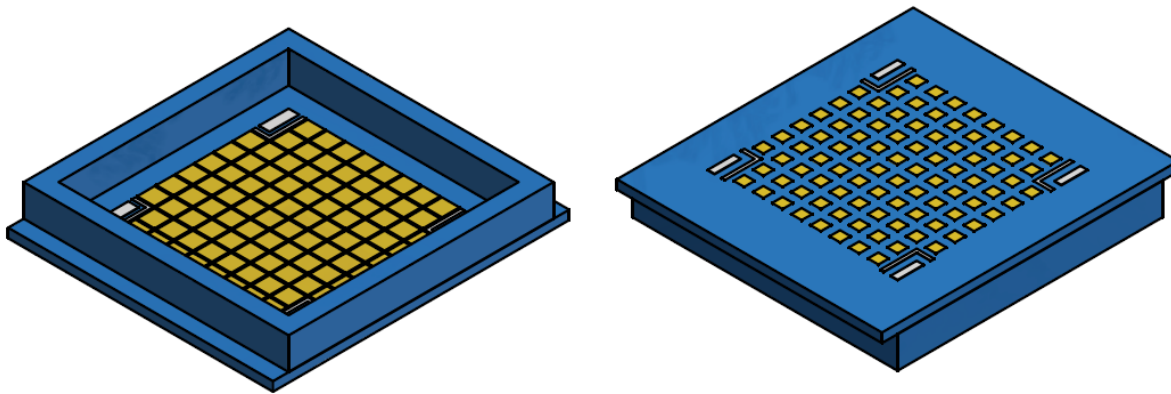
Current readout design is based on strip line readout
Various applications require pad readout

A new pad readout is designed and currently under fabrication

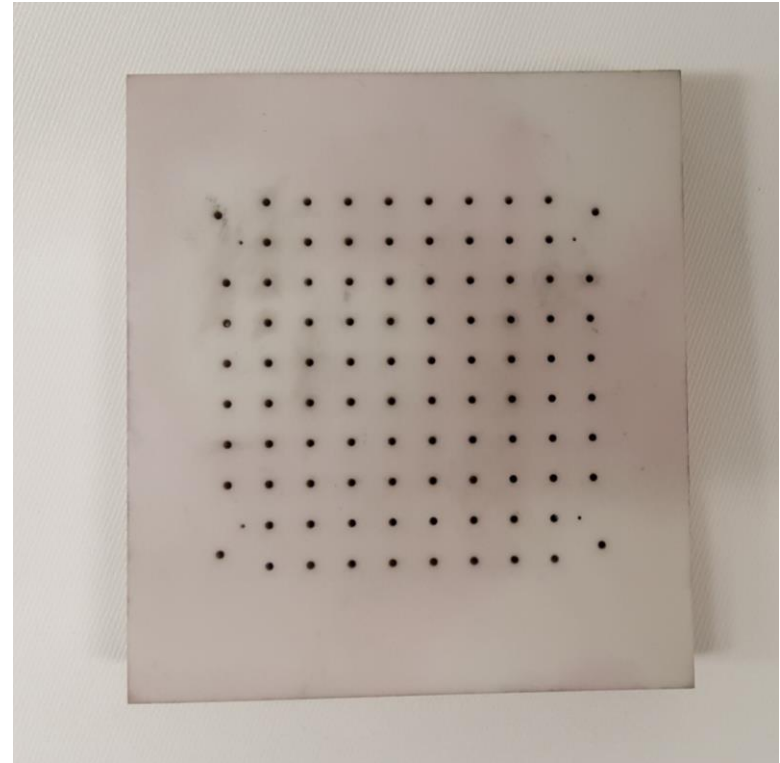
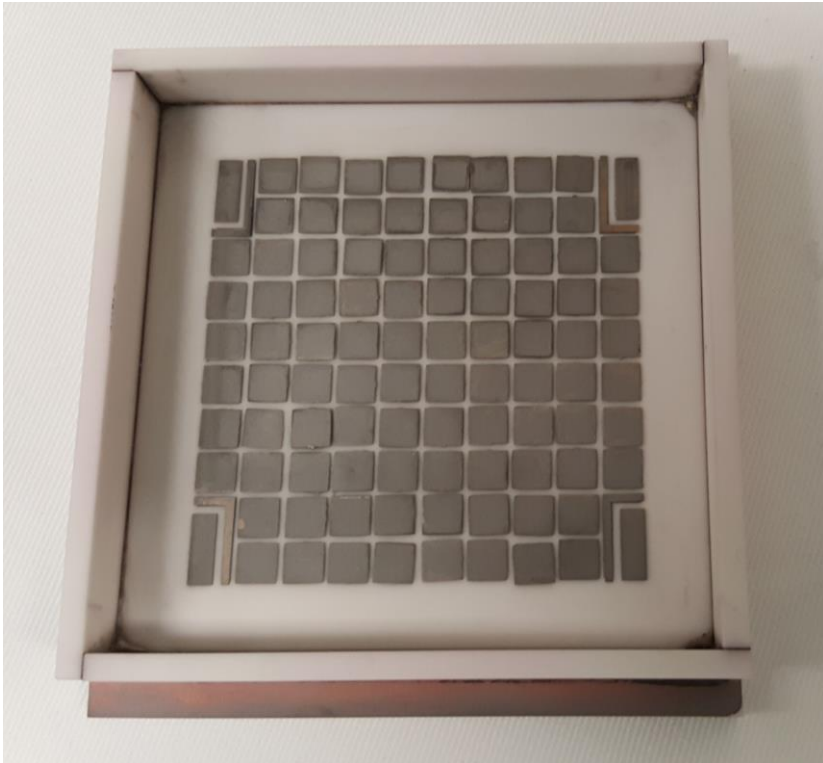
Inside and outside pads are made of copper and connected through a VIA
Base and side walls are made of ceramic

Version 1: 5 mm x 5 mm pad size and 0.5 mm spacing

Version 2: 2.25 mm x 2.25 mm pad size and 0.5 mm spacing



Pad tile as received from the vender company



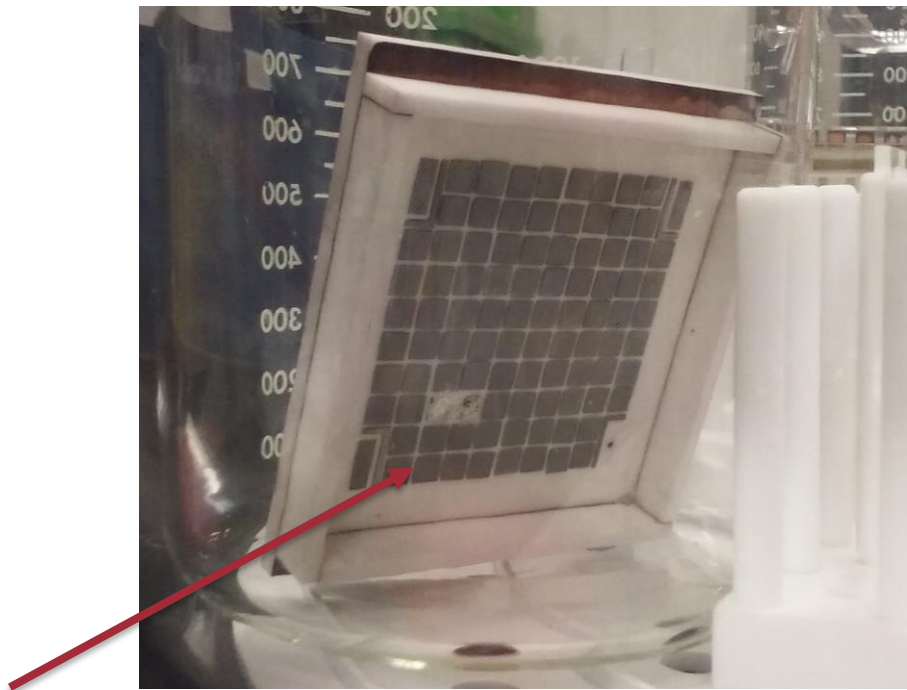
The received pad tile from the vender company has several defects:

- The readout pads on the inner side of the anode plate is not flat as requested
- The outside connections to these anode pads are not implemented.
- The side wall of the tile base is only 3mm thick, while we specified 5mm.



Pad tile after sonicating < 10 min

After we cleaned the tile base, three pads (two readout pads and one HV pad) detached from the anode plate, and an open hole showed up under the HV pad that fell off.



Unfortunately, the pad design with VIA failed due to technique difficulty



Current plan for pad readout

The vender company is making a second attempt to provide us a new pad tile, will see how it goes.

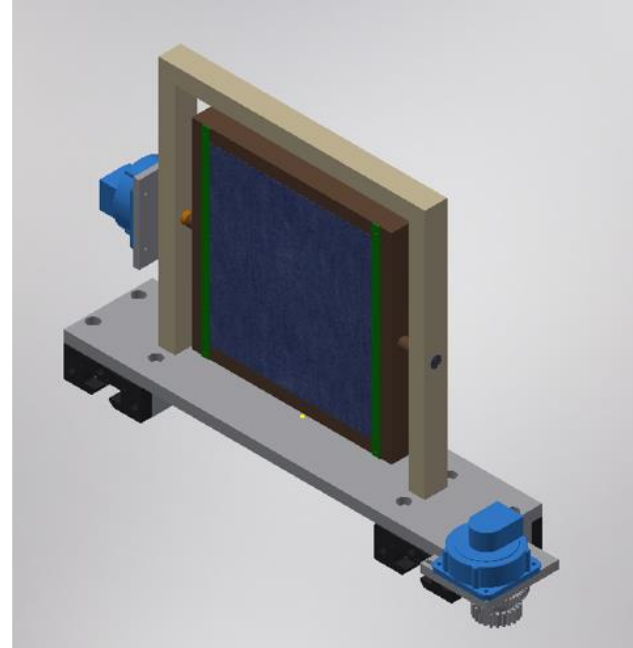
Meanwhile, we are working on pad readout detector through capacitive coupling design:

- The lower glass is coated with ALD, $10\text{k}\Omega$
- Pad sizes are directly designed on the electronic board to read out signals



Recent Progress

EIC Detector Magnetic Field Test Facility



(left) View of the test solenoid facility in the high-bay area at Argonne Bldg. 366.

(right) Self-designed test stand for 20 cm x 20 cm MCP magnetic field performance testing.

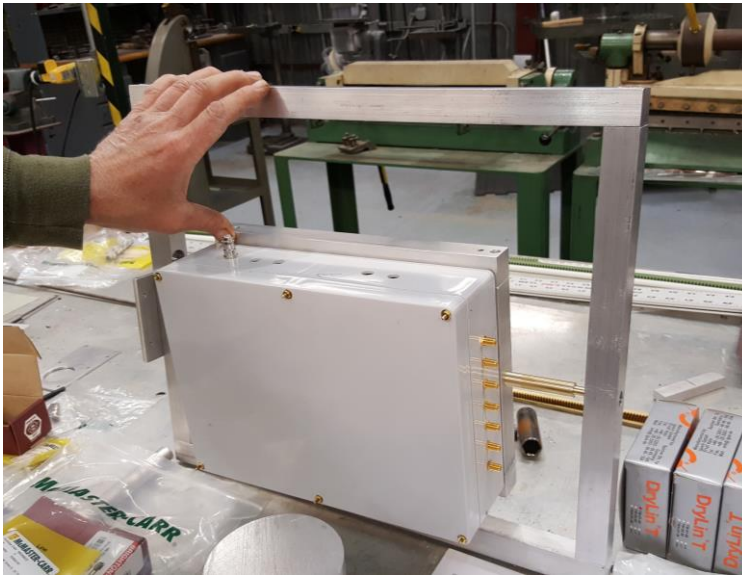
- A transporter with the capability of testing MCP-PMTs up to 20 cm x 20 cm
- All components are made of non-magnetic materials
- Electrically controlled router
- MCP-PMT center is aligned with the center of the magnetic facility



Test setup

Test stand base was built, all the required equipment are ready for MCP-PMT magnetic field test, currently working on commissioning.

Magnetic field test is scheduled on 6/19 – 6/30



20cm x 20cm LAPPD production

- Incom Inc. has successfully manufactured sealed LAPPDs
- LAPPD will be available to deliver to Argonne for characterization and magnetic field testing in August 2017.

INCOM

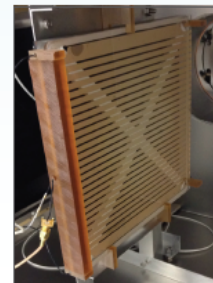
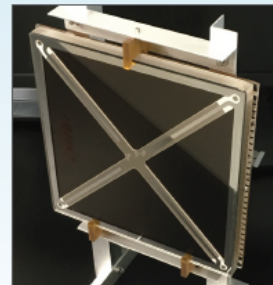
Bright Ideas in Fiber Optics

LAPPD™

Large Area Picosecond Photodetector

FEATURES:

- World's Largest Area:
230 mm x 220 mm
- Low Profile:
Only 22 mm thick
- High, Stable Gain:
Resistive and emissive coatings applied via ALD
- Low noise:
MCPs made with durable, low-alkali, borosilicate glass containing minimal Potassium 40



Package/Housing Characteristics

Housing Size	230 mm x 220 mm x 22 mm Thick
Housing Material	Borosilicate Glass
Window Material	Borosilicate or Fused Silica
Photocathode Material	Multi-Alkali (K ₂ NaSb)
Anode Configuration	28 silver strips, nominally 50Ω
Voltage Distribution	5 taps for independent control of voltage to the photocathode and entry and exit of MCP
Wavelength Sensitivity	<350 nm to >625 nm

Microchannel Plate (MCP) Characteristics

Arrangement	Two Positioned in a Chevron Pair
Dimensions	203 mm x 203 mm x 1.2 mm Thick
MCP Substrate	Borosilicate Glass
Capillary Pore Size	20 μm
Capillary Open Area Ratio (OAR)	65%
Typical Gain	1 x 10 ⁷
Resistive and Emissive Coatings	Applied via Atomic Layer Deposition (ALD)
Secondary Emission (SEE) Layer Material	Al ₂ O ₃

LAPPD Performance Demonstrated To Date

Quantum Efficiency (Q.E.) at 365 nm and 23°C	15% or better
Maximum Operating Voltage	3000 V
Temporal Resolution	Single PEs (photoelectrons): <100 ps, consistently <60 ps, typically Large Pulses: < 5 ps, predicted
Spatial Resolution	Single PEs: 1-3 mm Large Pulses: <1 mm

For more information, contact:
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INCOM

Bright Ideas in Fiber Optics



Future plan

Pixelated readout design

The vender company is making a second attempt to provide us a new pad tile, will see how it goes.

Work on pad readout detector through capacitive coupling design and produce a detector by Aug. 2017

Magnetic field test facility

Complete the commissioning

Test the available detectors in magnetic field on 6/19 – 6/30

20 cm x 20 cm LAPPD

Prepare facilities for LAPPD testing

Regular characterization and magnetic field testing

